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Mark Scheme (Results)

January 2022

Pearson BTEC Nationals
In Applied Science (31627H1C)
Unit 5: Principles and Applications of Science II - Chemistry

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Unit 5: Principles and Applications of Science II

General marking guidance

- All learners must receive the same treatment. Examiners must mark the first learner in exactly the same way as they mark the last.
- Marking grids should be applied positively. Learners must be rewarded for what they have shown they can do, rather than be penalised for omissions.
- Examiners should mark according to the marking grid, not according to their perception of where the grade boundaries may lie.
- All marks on the marking grid should be used appropriately.
- All the marks on the marking grid are designed to be awarded. Examiners should always award full marks if deserved. Examiners should also be prepared to award zero marks, if the learner's response is not rewardable according to the marking grid.
- Where judgement is required, a marking grid will provide the principles by which marks will be awarded.
- When examiners are in doubt regarding the application of the marking grid to a learner's response, a senior examiner should be consulted.

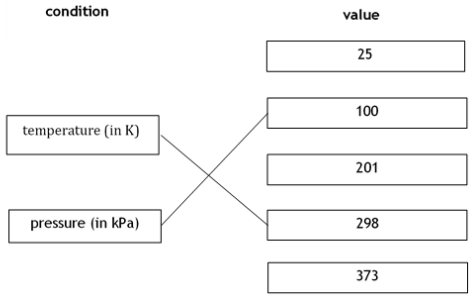
Specific marking guidance

The marking grids have been designed to assess learner work holistically. Rows in the grids identify the assessment focus/outcome being targeted. When using a marking grid, the 'best fit' approach should be used.

- Examiners should first make a holistic judgement on which band most closely matches the learner's response and place it within that band. Learners will be placed in the band that best describes their answer.
- The mark awarded within the band will be decided based on the quality of the answer, in response to the assessment focus/outcome and will be modified according to how securely all bullet points are displayed at that band.
- Marks will be awarded towards the top or bottom of that band, depending on how they have evidenced each of the descriptor bullet points.

BTEC Next Generation Mark Scheme

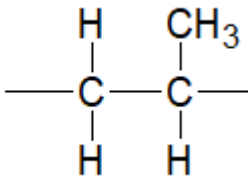
Question Number	Answer	Additional Guidance	Mark
1 (a)	**C** electrolysis		1
1 (b)(i)	$Al_2O_3 + \mathbf{6}H^+ \rightarrow \mathbf{2}Al^{3+} + \mathbf{3}H_2O$ Left-hand side balanced (1) Right-hand side balanced (1)		2
1 (b)(ii)	A hydroxide / $OH^{(-)}$ (1) B acid (1)		2
1 (c)	Award up to a maximum of **four** marks for any of the following: • has a high melting point (1) • has a lattice (of ions) / a giant (ionic) structure (1) • contains oppositely charged ions / positive and negative ions / cations and anions (1) • strong (electrostatic) forces (of attraction) between (ions) (1) • requires a lot of energy to overcome the {bonding / forces (of attraction between ions) / lattice} (1)	allow high boiling point	4
		Total	**9 marks**

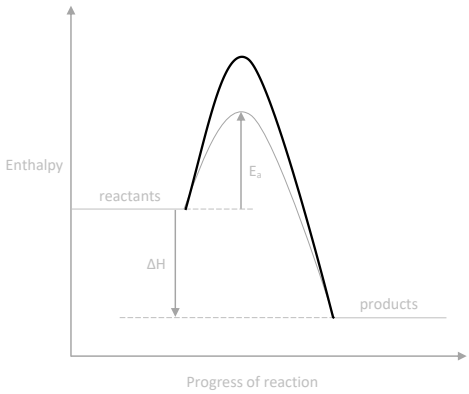
Question Number	Answer	Additional Guidance	Mark
2 (a)			2
2 (b)	Award up to a maximum of **two** marks for any of the following: (hydrogen gas) {is / exists} as an element (1) in standard state / under standard conditions (1) no change occurs (in this standard enthalpy change of formation) (1) Accept any other valid response.	 allow mark for a definition of standard enthalpy change of formation	2
2 (c)(i)	Multiplication of enthalpy of formation of H_2O (1) 2 x -242 Sum of $\Delta H_f^{\ominus}$ of reactants (1) -75 + [2 x -242] Substitution (1) -396 – [-75] – [2 x -242] Or -396 + 75 + 484 Evaluation (1) (+)163	accept (-)484 allow 2 x 242 accept (-)559 allow 396 - 75 – [2 x 242] ECF accept -396 + 75 + 242 or 396 – 75 - 242 max 3 marks for -163 or -79 award all 4 marks for correct answer only	4

2 (c)(ii)	sodium chloride or **any** named inorganic compound that is: • a soluble salt containing a metal more reactive than hydrogen • an acid • an alkali • a soluble metal oxide • a soluble acidic oxide Accept any other valid response.	allow brine	1
		Total	**9 marks**

Question Number	Answer	Additional Guidance	Mark
3 (a)(i)	methylpropene	allow (2-) methylprop (-1-) ene	1
3 (a)(ii)		allow any orientation of the formula	1
3 (a)(iii)	Any of the following points, up to a maximum of **three** marks: • W and X are (both) but-2-ene / the double bond is in the same position in chain for W and X / double bond is in a different position in the chain for V • {double bond / pi bond} restricts free rotation • Both W and X have two different {atoms / groups} on each carbon in the <u>double bond</u> / groups can be on same side or different side of <u>double bond</u> • W and X isomers have atoms arranged differently in space	allow W and X have same structural formula / V has a different structural formula allow V has same atoms / same groups on the same carbon in the <u>double bond</u> allow W = *cis* / *Z* isomer and X = *trans* / *E* isomer	3

3 (b)(i)	**D** C_8H_{18}		1
3 (b)(ii)	Award **one** mark for any of the following: • combustion • (burned as) a fuel • heating / energy source Accept any other valid response.	allow petrol	1

3 (b)(iii)	Award **one** mark for any of the following: • increase the temperature • increase the pressure • use steam • use a shorter (chain) hydrocarbon Accept any other valid response.	allow crack product further	1
3 (b)(iv)	 (2) each carbon in structure has four single bonds (1) rest of the repeat unit correct (1)	ignore brackets accept CH_3 drawn showing all bonds	2
		Total	**10 marks**

Question Number	Answer	Additional Guidance	Mark
4 (a)	**B** Endothermic / Exothermic		1
4 (b)	 Peak of graph is higher than original graph (1) Graph starts and ends at the same place as the original graph (1)		2
4 (c)	V_2O_5 / vanadium(V) oxide is regenerated / reformed by the end of the reaction (1) V_2O_5 / vanadium(V) oxide oxidises SO_2 / gives oxygen to SO_2 (1) V_2O_4 / vanadium(IV) oxide is oxidised by oxygen (1)	allow vanadium(V) oxide remains unchanged at end of reaction allow V_2O_5 is reduced (by SO_2) allow oxidation state of vanadium changes from +5 to +4 (initially) allow oxidation state of vanadium changes (back) from +4 to +5 If no other marks awarded then award 1 mark for: vanadium / transition element / catalyst can have variable oxidation states or vanadium / transition element / catalyst gains and loses electrons	3
		Total	**6 marks**

5	**Differences:** • Ethene is has a double bond / unsaturated, but ethane only has single bonds / is saturated • Hydrogen chloride / HCl is a reactant in Figure 3, but is a product in Figure 4 / chlorine is the reactant in Figure 4 • Figure 3 is (electrophilic) addition (the combination of two molecules to form one new molecule) but Figure 4 is (free radical) substitution (the replacement of one atom with another) • Figure 3 has only one product so has better atom economy / no waste compared to Figure 4 • Figure 4 reaction requires more energy as it needs uv light, whilst Figure 3 reaction occurs at room temperature and pressure • Energy (from uv light) is needed to break the chlorine bond in Figure 4, but pi bond is weak / breaks easily in Figure 3 • Intermediate is a carbocation / positive ion in the ethene reaction but is a free radical in the ethane reaction • Hydrogen adds to ethene / double bond in Figure 3 to form the carbocation intermediate • Chlorine free radical removes hydrogen atom from ethane in Figure 4 to form free radical intermediate **Similarities:** • Both ethene and ethane have two carbon atoms • The other reactant contains chlorine • Intermediate in both reactions is an ethyl group / C_2H_5 • Both involve HCl

Mark scheme (award up to 6 marks) refer to the guidance on the cover of this document for how to apply levels-based mark schemes*.		
Level	**Mark**	**Descriptor**
Level 0	0	No rewardable material.
Level 1	1-2	• Adequate interpretation, analysis and/or evaluation of the scientific information with generalised comments being made • Generic statements may be presented rather than linkages to the context being made so that lines of reasoning are unsupported or partially supported • The comparison will contain some similarities and differences showing some structure and coherence
Level 2	3-4	• Good analysis, interpretation and/or evaluation of the scientific information • Lines of argument mostly supported through the application of relevant evidence drawn from the context • Demonstrate an awareness of both similarities and differences leading to a comparison which has a structure which is mostly clear, coherent and logical
Level 3	5-6	• Comprehensive analysis, interpretation and/or evaluation of all pieces of scientific information • Line(s) of argument consistently supported throughout by sustained application of relevant evidence drawn from the context • The comparison shows a logical chain of reasoning which is supported throughout by sustained application of relevant evidence

Ofqual
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